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(54) **DUAL CURE BINDER SYSTEMS****ZWEIFACH HÄRTBARES BINDEMITTELSYSTEM****SYSTEMES DE LIAISON A DOUBLE DURCISSEMENT**

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(73) Proprietor: **NORTON COMPANY**
Worcester, Massachusetts 01615-0138 (US)

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(72) Inventors:

- **SWEI, Gwo, Shin**
East Amherst, NY 14051 (US)
- **GAETA, Anthony, C.**
Rockport, NY 14094 (US)
- **YANG, Wen, Liang, Patrick**
Ballston Lake, NY 12019 (US)
- **CERCENA, Jane, L.**
Ashford, CT 02678 (US)

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(74) Representative: **Richebourg, Michel François**
Cabinet Michel Richebourg,
"Le Clos du Golf",
69, rue Saint-Simon
42000 Saint Etienne (FR)

EP 0 830 238 B1

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EP 0 830 238 B1**Description**Background of the Invention

5 [0001] This invention relates to a process for the production of coated abrasives using a dual-curing binder system comprising a "bifunctional" binder.

[0002] In the conventional production of coated abrasives, a backing material is coated with a first resin coat, known as a maker coat, and a layer of abrasive particles are deposited thereon either by gravity coating or by an electrostatic projection, ("UP"), process. The function of the maker coat is to act as a primary anchor firmly bonding the grits to the
10 backing. This maker coat is cured to ensure that the bond is firm before the main coating that holds the grits rigidly during grinding is applied. This is known as the size coat. The size coat is then cured, and occasionally a supersize coat is applied over the top to provide a grinding aid, antistatic additive or other adjuvant close to the point at which the coated abrasive contacts the surface to be ground when in use.

[0003] For many years phenolic resins have been the preferred component of the size coat on account of their
15 excellent physical properties. They have also been preferred as the maker coat, partly because of their excellent adhesion to conventional backing materials and phenolic size coats. By using such similar binder coats it is possible to partially cure the maker and complete the cure at the same time as the cure of the size coat. Phenolics are also popular because they are cheap and because they are applied in an aqueous solution such that no organic solvents that need to be recycled or disposed of in an environmentally acceptable manner are involved.

[0004] Phenolic resins have drawbacks however, including the need to remove water before cure is initiated. In addition the prolonged heating required to complete a uniform cure without blistering often lasts many hours. The process of curing is usually operated in a continuous mode wherein a coated abrasive sheet many meters in length is fed slowly into long ovens. The ovens in which the cure occurs are called festoon ovens and the product to be cured is draped in long folds over support slats and these folds move at a pre-determined rate through the oven. The supports
20 over which the sheet is folded often cause defects on the back of the sheet and a misorientation of the grain in the other surface where the maker resin is receiving the initial cure.

[0005] For this reason there have been many suggestions for replacement of phenolic resins by other binder products.

[0006] It has been proposed for example, to use acrylate resins, urea-formaldehyde resins, polyurethane resins, polyester resins, melamine resins, epoxy resins, and alkyd resins.

[0007] Some of these are curable by radiation treatment such as by the use of UV light or electron beam radiation. These can be quite expensive and have limitations on the amount of conventional filler material because the particles can prevent effective cure of the parts of the resin binder in the "shadows" behind the particles where little or no radiation penetrates. UV cure radiation has a quite shallow depth of cure in most situations in fact. Electron beam radiation has greater depth of cure but if the dosage is large, the backing material may be deteriorated, leading to premature product
35 failure.

[0008] The other binders proposed, while often being well-adapted to specialized uses such as lightweight or waterproof abrasives or very fine grit abrasive products, in general do not provide sufficient strength and efficiency to displace the versatile phenolic resins that are used in the greatest number of coated abrasive products.

[0009] A binder formulation has now been discovered that is extremely versatile and effective, particularly when used
40 as a maker coat and the present invention provides a process for making coated abrasive using such a binder.

General Description of the Invention

[0010] According to a first aspect of this invention there is provided a process for the production of a coated abrasive
45 comprising:

- a. Forming an abrasive layer on a backing material, said abrasive layer comprising abrasive grits and a bi-functional binder formulation comprising a bifunctional compound having at least one radiation-curable functional group and at least one thermally curable functional group per molecule;
- 50 2. Using radiation to at least partially cure the radiation-curable functional groups; and
- 3 Subsequently completing the cure by activation of the thermally curable functional group.

[0011] The binder component is described being "bi-functional" and by this intended that the binder contain two different types of functional groups that cure by different mechanisms. It is however contemplated the each molecule
55 of binder may have more than one, for example from 1 to 3 or even more of each type of functional group. Preferred binders however have one of both kinds of functional group.

[0012] According to a further aspect of this invention, the partial cure of the bi-functional binder is followed by deposition of a phenolic size coat which is then thermally cured at the same time as the cure of the bi-functional binder is

EP 0 830 238 B1

completed.

[0013] A further aspect of the invention is the use of a maker coat that comprises a bi-functional compound having at least one radiation-curable function and at least one thermally-curable function, wherein the compound is a liquid in the uncured state. Since the maker is itself a liquid, no solvent need be removed before curing can be initiated, thus greatly accelerating the curing process. Such formulations are referred to as having 100% solids, indicating thereby that no weight is lost upon cure.

[0014] In a further embodiment of the invention the binder layer comprising the bifunctional component may be applied as a size coat, that is, over the top of a layer of abrasive particles adhered to the backing by means of a conventional maker resin layer, (such as a phenolic resin maker coat), or over a maker coat that also comprises a bi-functional binder component.

[0015] The bi-functional compound comprises at least one and often as many as three or more radiation-curable functions, by which is meant groups that react with similar groups when activated by radiation such as UV light or an electron beam. The reaction may be initiated by free-radical or cationic initiation and of course different species of initiators or promoters are applicable in each case. Typical radiation-curable functions include unsaturated groups such as vinyl, acrylates, methacrylates; ethacrylates, cycloaliphatic epoxides and the like. The preferred UV-curable functions are acrylate groups. Where the bi-functional compound comprised a single UV-curable group, it may be desirable to incorporate a minor amount of a further compound containing groups reactive with the UV-curable group such as diacrylates, tri-acrylates and N-vinylpyrrolidone. Suitable reactive diluents include trimethylol propane triacrylate, (TMPTA); triethylene glycol diacrylate (TRPGDA); hexane diol-diacrylate, (HDODA); tetraethylene glycol diacrylate, (TEGDA); N-vinyl pyrrolidone (NVP) and mixtures thereof. Such additives are very effective in adjusting initial viscosity and determining the flexibility of the cured formulation. They may be added in amounts up to about 50% by weight. This permits control over the formulation viscosity, the degree of cure and the physical properties of the partially cured bi-functional compound. In addition it is preferred that such added reactive compounds be liquid or soluble in the mixture as to add no solvent that needs to be removed prior to cure.

[0016] Cure by means of UV radiation is usually sufficient to ensure adequate retention of the abrasive grains during subsequent processing before curing of the thermally curable functions is completed.

[0017] The thermally-curable function may be provided for example by epoxy groups, amine groups, urethanes or unsaturated polyesters. The preferred thermally curable function is however the epoxy group since this will result in a plurality of terminal hydroxyl groups on the cured binder which would ensure that a size coat deposited thereon and comprising a resin that will react with the epoxy group such as phenolics, urea/formaldehyde resins and epoxy resins would bond firmly thereto, so decreasing the risk of de-lamination during use.

[0018] Cure of the thermally-curable functions is preferably accelerated or promoted by the addition of known catalysts such as peroxides or 2-methyl-imidazole.

[0019] The backbone of the bifunctional binder is not critical beyond providing a stable, essentially nonreactive support for the functional groups that does not interfere with the cure reactions. A suitable backbone is based on a bisphenol derivative such as bisphenol A or bisphenol E. Other possible backbones may be provided by novolacs, urethanes, epoxy-novolacs and polyesters.

[0020] These backbone compounds can be reacted by known techniques to form terminal epoxide groups which are of course thermally curable. Such epoxidized backbone materials are well-known. To obtain the bi-functional binder components of the invention this epoxidized derivative is then reacted with a compound containing a function that is reactable with the epoxide function and also contains a radiation-curable function. The amount of the compound added is less than the stoichiometric amount that is required to react with all the epoxide functions present in the molecule. A typical compound may contain an acrylic or methacrylic group and an active-hydrogen containing group, and suitable examples include acrylic and methacrylic acids. The active hydrogen-containing group reacts with the epoxide group, replacing that (thermally-curable) functionality with a (radiation-curable) (meth)acrylate functionality.

[0021] The relative amounts of the epoxidized backbone and the radiation curable compound are important in that they control the relative degrees of curing that can occur in the radiation and thermal curing phases of the complete cure of the bi-functional binder compound. Usually the ratio of thermally curable groups to radiation-curable groups in the bifunctional binder is from 1:2 to 2:1 and most preferably about 1:1.

Detailed Description of the Invention

[0022] The bi-functional binder composition can be applied directly to the backing and then receive a coating of the abrasive grit. Alternatively a mixture of the grit and binder can be made and this mixture is then applied directly to the backing material. This is most frequently done when the abrasive grit is very fine and the application for which the coated abrasive is intended in a fining or finishing application. In such situations a subsequent size coat application may be unnecessary.

[0023] The binder composition can additionally contain catalysts or activators designed to initiate or accelerate the

EP 0 830 238 B1

radiation or thermal cure operations. It can also include filler materials. It is however, preferred that such fillers do not interfere with the radiation curing whether because of the amount or size of the particles or because the material is essentially UV transparent much as aluminum tri-hydrate. Fillers may often be treated with a coupling agent such as a silane which results in improved adhesion between the filler and the binder so as to increase the dispersion and retention of the filler in the formulation. Addition of fillers is very effective to reduce the cost of the binder system and at the same time increase the physical strength of the cured binder layer. The addition of a filler treated with a coupling agent is therefore a preferred feature of the binder formulations according to the invention.

[0024] A preferred bifunctional binder formulation component is an epoxy-acrylate with a bisphenol A backbone reacted at each end to provide epoxy groups, one of which is then acrylated by reaction with acrylic acid. A resin of this description is available from UCB Chemicals under the registered trademark Ebecryl 3605.

[0025] The above bifunctional binder, (styled hereafter "3605"), was evaluated in a number of experiments to determine the extent of cure measured by the amount of heat evolved, (Joules/g), by either differential photo calorimetry, (for the UV cure), or differential scanning calorimetry, (for thermal cure). In each case the glass transition temperature, (Tg), is measured. This to indicates the degree of cure attained, with higher Tg values equated to higher degrees of cure.

[0026] The same amount of 3605 was used in each case and the amount (if any) of initiator or catalyst is indicated. The additives used were:

Darocure 1173, (a free radical photo initiator of UV Cure available from Ciba-Geigy);

Cyracure UV1-6974, (a cationic photo initiator of UV cure available from Union Carbide Corporation);

2MI (2-methylimidazole which is a thermal cure initiator); and

TBHP (t-butyl hydroperoxide which is an initiator of thermal cure).

In most cases an additional thermal cure was applied to complete the cure. The Tg at each stage was measured.

Cure Mode/Additive	Heat Generated (J/g)	Tg(°C)	Tg after added Ther. Cure (°C)
UV/3% 1173	152.6	23.38	27.97
Therm./2% TBHP	254	31.98	34.46
UV/4% 6974	130.9	24.81	71.1
Thermal/2% 2MI	93.95	24.78	—
UV/3% 1173 + 2% 6974	163.4(UV)	35.34	91.91
UV + Thermal/ 3% 1173+2% 2MI	126.7(UV) 42.84(Thermal)	45.98	55.29
*Thermal + UV/ 2% 2MI+3% 1173	98.44(Thermal) 0.7(UV)	19.15	25.66

* If the cure of the thermally polymerizable groups precedes that of the UV curable groups, the latter polymerization is significantly inhibited and retarded. For this reason the reverse order of activation is usually preferred.

[0027] It will be noted that the addition of a subsequent thermal cure operation after the bi-functional binder functions have been cured resulted in enhanced properties and this is a preferred feature of the present invention.

[0028] To save expense, the binder formulation according to the invention, when applied as a maker coat, can be pattern-coated on the backing such that when abrasive grits are applied to the backing material, they adhere only to the binder in the applied pattern. Because the binder can then be radiation-cured in seconds, the grain is retained in place and a size applied over the top will penetrate between the grains and bond directly to the backing. This is particularly advantageous if the size coat is a phenolic resin and the backing is of a hydrophilic nature such that the phenolic resin bonds readily thereto. It may also be desirable to incorporate reactive fillers into such size coating so as to ensure optimum placement at all stages during the grinding.

Description of Specific Embodiments

[0029] The invention is now described with reference to specific formulations. These are not however to be understood as implying any limitation on the essential scope of the invention.

[0030] A typical fiber-backed abrasive disc using fused alumina/zirconia grits and phenolic maker and size coats were duplicated with the difference that a binder formulation according to the invention was substituted for the phenolic maker coat.

EP 0 830 238 B1

[0031] The binder formulation had the composition;

Reactants: 3605 (bifunctional binder)	80% by wt.
N-vinylpyrrolidone	20% by wt.
Additives: 2MI (Initiator)	1% of reactants wt.
1173 (Initiator)	3% of reactant wt.
Al(OH) ₃ (7.5m)	50% of reactant wt.

The grit sizes used were 80 grit.

The binder formulation was applied at about 267 g/m², (18 lbs/ream). The samples were UP-coated with grit at 178 g/m², (12 lbs/ream). Two sheets were produced.

[0032] The samples were cured using UV light, (set on "high", with a speed of passage under the light source of 3.05 m/min., (10 ft/minute), with each sheet given two passages to ensure complete cure.

[0033] The sheet samples with maker coats as described above were then treated with a commercial phenolic size coat at an add-on weight of 207 g/m², (14 lbs/ream).

[0034] Both sheets were then cured as follows:

1 hour at 65.6°C (150°F);

1 hour at 79.4°C (175°F); and

16 hours at 107.2°C (225°F).

[0035] 7" discs were cut from these sheets and tested by angle grinding on the edge of a 3.18 mm, (one eighth inch), thick bar of C-1018 steel.

[0036] The disc was supported on a pad and urged against the steel bar at 3.64 kg or 2.73 kg; (8 lbs or 6 lbs respectively) at an angle of 15° or 10° respectively and moved relative to the bar. The time of contact in each case was 30 seconds. The weight loss of the disc and the bar were measured after each contact and after each contact the condition of the edge was examined. The results were as follows:

Sample #	Contact	Disc 1st Change	Bar at change	Ratio	Comments on Edge
1 (15° angle, 8 lb weight), Hand pad backing	1	0.99g.	11.34g.	11.45	Acceptable
	2	0.30g.	12.15g.	40.50	Acceptable
	3	0.15	10.52	70.13	Acceptable (New Bar)
	4	0.16	10.88	68.00	Acceptable
2 (10° angle, 6 lb. wt. Soft pad backing)	1	0.83	12.20	14.70	Not very good
	2	0.20	9.97	49.85	Acceptable
	3	0.07	10.17	145.29	Acceptable (New Bar)
	4	0.04	9.65	241.25	Acceptable (New Bar)

[0037] The performance of the discs was comparable to that of commercial all-phenolic binder discs. It was noticeable that the phenolic size coat adhered extremely well to the maker coat according to the invention.

Claims

1. A process for the production of a coated abrasive which comprises

a. Forming an abrasive layer on a backing material, said abrasive layer comprising abrasive grits and a bi-functional binder formulation which comprises a bi-functional compound having at least one radiationcurable functional group and at least one thermally curable functional group per molecule;

b. Using radiation to at least partially cure the radiation-curable functional groups; and

c. Subsequently completing the cure by activation of the thermally curable functional groups.

2. A process according to Claim 1 in which the bi-functional compound comprises both UVcurable and thermally

EP 0 830 238 B1

curable functional groups.

3. A process according to Claim 1 in which the radiation-curable functional groups are acrylate, methacrylate or cycloaliphatic epoxy groups .
4. A process according to Claim 1 in which the thermally-curable functional groups are epoxy groups.
5. A process according to Claim 1 in which the bi-functional binder composition is applied as a maker coat and the abrasive grits are deposited thereon.
6. A process according to Claim 5 in which the bi-functional binder composition is pattern-coated on the backing material.
7. A process according to Claim 1 in which the bifunctional binder composition is added as a component of a size coat.
8. A process according to Claim 1 in which a size coat comprising a resin having groups reactable with the bi-functional binder is applied over the abrasive layer.
9. A process according to Claim 8 in which the size coat comprises a phenolic resin.
10. A process according to Claim 8 in which the size coat is cured at the same time as the thermally curable function of the bi-functional binder formulation.
11. A process according to Claim 1 in which the bi-functional binder formulation is 100% solids.
12. A process according to Claim 1 in which the bi-functional binder formulation comprises additional monomers or oligomers containing one or more groups copolymerizable with the radiation-polymerizable functional groups of the bi-functional compound.
13. A process according to Claim 1 in which the bi-functional binder formulation also comprises a filler.
14. A process according to Claim 13 in which the filler has been surface treated with a coupling agent to increase its compatibility with the binder.
15. A process according to Claim 1 in which, after the cure of the bi-functional binder component is essentially complete, the coated abrasive product is subjected to a further thermal cure operation.
16. A process for the production of a coated abrasive which comprises:
 - a. Coating a backing layer with a maker formulation comprising a compound having at least one UV-curable (meth)acrylate group and at least one thermally-curable epoxy group per molecule;
 - b. Applying a layer of abrasive grits to the maker formulation;
 - c. Exposing the maker coat to UV radiation sufficient to at lease partially cure the UV-curable (meth)acrylate groups; and
 - d. Subsequently curing the epoxy groups.
17. A process according to Claim 16 in which the maker formulation comprises other groups copolymerizable with the (meth)acrylate groups.
18. A process according to Claim 16 in which the maker coat is 100% solids.
19. A process according to Claim 16 in which a phenolic size coat is applied over the abrasive process and is cured at the same time as the thermally curable functional groups of the maker coat.
20. A process according to Claim 16 in which the maker formulation is pattern-coated on the backing material.
21. A process according to Claim 16 in which the coated abrasive is subjected to a thermal cure operation after the cure of the bi-functional binder component is essentially complete.

EP 0 830 238 B1

22. A process according to Claim 16 in which the bi-functional binder formulation also comprises a filler that has been surface modified by reaction with a silane.

23. A process according to Claim 22 in which the binder formulation further comprises compounds copolymerizable with the radiation-curable acrylate groups.

24. A process according to Claim 22 in which the binder formulation further comprises a filler.

25. A process according to Claim 24 in which the filler has been silane-modified.

Patentansprüche

1. Verfahren zur Herstellung eines beschichteten Schleifmittels, umfassend:

a. Bilden einer schleifenden Schicht auf einem Trägermaterial, wobei die schleifende Schicht Schleifkörner und eine bifunktionelle Bindemittelformulierung umfaßt, die eine bifunktionelle Verbindung mit mindestens einer strahlungshärtenden funktionellen Gruppe und mindestens einer thermisch härtenden funktionellen Gruppe pro Molekül umfaßt;

b. Verwendung von Strahlung, um die strahlungshärtenden funktionellen Gruppen mindestens teilweise auszuhärten; und

c. nachfolgendes Vervollständigen der Aushärtung durch Aktivierung der thermisch härtenden funktionellen Gruppen.

2. Verfahren nach Anspruch 1, bei dem die bifunktionelle Verbindung sowohl UV-härtende als auch thermisch härtende funktionelle Gruppen umfaßt.

3. Verfahren nach Anspruch 1, bei dem die strahlungshärtenden funktionellen Gruppen Acrylat, Methacrylat oder cycloaliphatische Epoxygruppen sind.

4. Verfahren nach Anspruch 1, bei dem die thermisch härtenden funktionellen Gruppen Epoxygruppen sind.

5. Verfahren nach Anspruch 1, bei dem die bifunktionelle Bindemittelzusammensetzung als Grundierungsbeschichtung (maker coat) aufgetragen wird und die Schleifkörner darauf aufgebracht werden.

6. Verfahren nach Anspruch 5, bei dem die bifunktionelle Bindemittelzusammensetzung auf dem Trägermaterial als Teilflächenbeschichtung (pattern-coated) aufgetragen wird.

7. Verfahren nach Anspruch 1, bei dem die bifunktionelle Bindemittelzusammensetzung als ein Bestandteil einer Ganzflächenbeschichtung (size coat) zugesetzt wird.

8. Verfahren nach Anspruch 1, bei dem eine Ganzflächenbeschichtung auf die schleifende Schicht aufgetragen wird, die ein Harz umfaßt, das Gruppen enthält, die mit dem bifunktionellen Bindemittel reagieren können.

9. Verfahren nach Anspruch 8, bei dem die Ganzflächenbeschichtung ein phenolisches Harz umfaßt.

10. Verfahren nach Anspruch 8, bei dem die Ganzflächenbeschichtung zur gleichen Zeit wie die thermisch härtende Funktion der bifunktionellen Bindemittelformulierung ausgehärtet wird.

11. Verfahren nach Anspruch 1, bei dem die bifunktionelle Bindemittelformulierung 100 % Feststoffanteil umfaßt.

12. Verfahren nach Anspruch 1, bei dem die bifunktionelle Bindemittelformulierung zusätzliche Monomere oder Oligomere umfaßt, welche eine oder mehrere Gruppen enthalten, die mit den strahlungspolymerisierbaren funktionellen Gruppen der bifunktionellen Verbindung copolymerisierbar sind.

13. Verfahren nach Anspruch 1, bei dem die bifunktionelle Bindemittelformulierung ferner einen Füllstoff umfaßt.

14. Verfahren nach Anspruch 13, bei dem der Füllstoff mit einem Kupplungsreagenz oberflächenbehandelt wurde, um

EP 0 830 238 B1

dessen Kompatibilität mit dem Bindemittel zu erhöhen.

- 5 15. Verfahren nach Anspruch 1, bei dem das beschichtete schleifende Produkt einer weiteren thermischen Aushärtungsoperation unterzogen wird, nachdem die Aushärtung der bifunktionellen Bindemittelkomponente im wesentlichen vollständig ist.
- 10 16. Verfahren zur Herstellung eines beschichteten Schleifmittels, welches umfaßt:
- a. Beschichten einer Trägerschicht mit einer Grundierungsformulierung umfassend eine Verbindung mit mindestens einer UV-härtenden (Meth)acrylat-Gruppe, sowie mindestens einer thermisch härtenden Epoxygruppe pro Molekül;
 - b. Auftragen einer Schicht aus Schleifkörnern auf die Grundierungsformulierung;
 - c. Aussetzen der Grundierungsbeschichtung an UV-Strahlung, welche ausreicht, um die UV-härtenden (Meth)acrylat-Gruppen zumindest teilweise auszuhärten; und
 - 15 d. nachfolgendes Aushärten der Epoxygruppen.
- 20 17. Verfahren nach Anspruch 16, bei dem die Grundierungsformulierung andere Gruppen umfaßt, die mit den (Meth)acrylat-Gruppen copolymerisierbar sind.
18. Verfahren nach Anspruch 16, bei dem die Grundierungsbeschichtung 100 % Feststoffanteil umfaßt.
19. Verfahren nach Anspruch 16, wobei eine phenolische Ganzflächenbeschichtung über die schleifende Schicht aufgetragen wird, und gleichzeitig mit den thermisch härtenden funktionellen Gruppen der Grundierungsbeschichtung ausgehärtet wird.
- 25 20. Verfahren nach Anspruch 16, bei dem die Grundierungsformulierung als Teilflächenbeschichtung auf dem Trägermaterial aufgebracht wird.
- 30 21. Verfahren nach Anspruch 16, bei dem das beschichtete Schleifmittel einer thermischen Aushärtungsoperation unterzogen wird, nachdem die Aushärtung der bifunktionellen Bindemittelkomponente im wesentlichen vollständig ist.
22. Verfahren nach Anspruch 16, bei dem die bifunktionelle Bindemittelformulierung ferner einen Füllstoff umfaßt, der durch Umsetzung mit einem Silan oberflächenmodifiziert wurde.
- 35 23. Verfahren nach Anspruch 22, bei dem die Bindemittelformulierung ferner Verbindungen umfaßt, die mit den strahlungshärtenden Acrylatgruppen copolymerisierbar sind.
24. Verfahren nach Anspruch 22, bei dem die Bindemittelformulierung ferner einen Füllstoff umfaßt.
- 40 25. Verfahren nach Anspruch 24, bei dem der Füllstoff Silan-modifiziert wurde.

Revendications

- 45 1. Procédé pour la fabrication d'un abrasif recouvert qui comprend
- a la formation d'une couche abrasive sur un matériau de support, ladite couche abrasive comprenant des
 - 50 particules abrasives et une formulation de liant bi-fonctionnel qui comprend un composé bi-fonctionnel présentant au moins des groupes fonctionnels durcissables par rayonnement et au moins un groupe fonctionnel par molécule durcissable thermiquement ;
 - b. l'utilisation d'un rayonnement pour au moins partiellement durcir les groupes fonctionnels durcissables par rayonnement ; et
 - 55 c. l'achèvement ultérieur du durcissement par activation des groupes fonctionnels thermiquement durcissables.
2. Procédé selon la revendication 1, dans lequel le composé bi-fonctionnel comprend à la fois des groupes fonctionnels durcissables thermiquement et durcissables par UV.

EP 0 830 238 B1

3. Procédé selon la revendication 1 dans lequel les groupes fonctionnels durcissables par rayonnement sont des groupes époxy cycloaliphatiques ou méthacrylates, acrylates.
- 5 4. Procédé selon la revendication 1 dans lequel les groupes fonctionnels durcissables thermiquement sont des groupes époxy.
5. Procédé selon la revendication 1 dans lequel la composition de liant bi-fonctionnel est appliquée comme couche intermédiaire (« maker coat ») et des particules abrasives sont déposées sur cette dernière.
- 10 6. Procédé selon la revendication 5 dans lequel la composition de liant bi-fonctionnel est recouverte d'un motif (pattern-coated) sur le matériau de support.
7. Procédé selon la revendication 1 dans lequel la composition de liant bi-fonctionnel est ajoutée comme composant d'une couche d'apprêt (« size coat »).
- 15 8. Procédé selon la revendication 1 dans lequel une couche d'apprêt comprenant une résine présentant des groupes qui réagissent avec le liant bi-fonctionnel, est appliquée sur la couche abrasive.
9. Procédé selon la revendication 8 dans lequel la couche d'apprêt comprend une résine phénolique.
- 20 10. Procédé selon la revendication 8 dans lequel la couche d'apprêt est durcissable en même temps que la fonction durcissable thermiquement de la formulation de liant bi-fonctionnel.
11. Procédé selon la revendication 1 dans lequel la formulation de liant bi-fonctionnel est formée de 100% de solides.
- 25 12. Procédé selon la revendication 1 dans lequel la formulation de liant bi-fonctionnel comprend des monomères ou oligomères additionnels contenant au moins un groupe copolymérisable avec les groupes fonctionnels polymérisables par rayonnement du composé bi-fonctionnel.
- 30 13. Procédé selon la revendication 1 dans lequel la formulation de liant bi-fonctionnel comprend également une charge.
14. Procédé selon la revendication 13 dans lequel la charge a été traitée en surface avec un agent de couplage (« coupling agent ») pour augmenter sa compatibilité avec le liant.
- 35 15. Procédé selon la revendication 1 dans lequel, après que le durcissement du composant de liant bi-fonctionnel soit essentiellement achevé, le produit abrasif recouvert est soumis à une opération de traitement thermique supplémentaire.
- 40 16. Procédé pour la fabrication d'un abrasif recouvert qui comprend :
 - a le revêtement d'une couche de support avec une formulation intermédiaire comprenant un composé présentant au moins un groupe de (méth)acrylate durcissable par UV et au moins un groupe époxy durcissable thermiquement par molécule ;
 - 45 b. l'application d'une couche de particules abrasives à la formulation intermédiaire ;
 - c. l'exposition de la couche intermédiaire au rayonnement UV de manière suffisante pour au moins partiellement durcir les groupes (méth)acrylates durcissables par UV ; et
 - d. le durcissement ultérieur des groupes époxy.
- 50 17. Procédé selon la revendication 16 dans lequel la formulation intermédiaire comprend d'autres groupes copolymérisables avec les groupes (méth)acrylates.
18. Procédé selon la revendication 16 dans lequel la couche intermédiaire est formée de 100% de solides.
- 55 19. Procédé selon la revendication 16 dans lequel une couche d'apprêt phénolique est appliquée sur le procédé abrasif et est durcie en même temps que les groupes fonctionnels durcissables thermiquement de la couche intermédiaire.
20. Procédé selon la revendication 16 dans lequel la formulation intermédiaire est recouverte d'un motif sur le matériau de support.

EP 0 830 238 B1

21. Procédé selon la revendication 16 dans lequel l'abrasif recouvert est soumis à une opération de durcissement thermique après que le durcissement du composant de liant bi-fonctionnel soit essentiellement achevé.
- 5 22. Procédé selon la revendication 16 dans lequel la formulation de liant bi-fonctionnel comprend également une charge qui a été modifiée en surface par réaction avec un silane.
23. Procédé selon la revendication 22 dans lequel la formulation de liant comprend en outre des composés copolymérisables avec les groupes acrylates durcissables par rayonnement.
- 10 24. Procédé selon la revendication 22 dans lequel la formulation de liant comprend en outre une charge.
25. Procédé selon la revendication 24 dans lequel la charge a été modifiée en silane.

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